

DESIGN CRITERIA FOR PLANT REINFORCEMENT
UPGRADING FROM FOUR-PARTY TO ALL ONE-PARTY

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1. GENERAL

- 1.1 This section provides borrowers, consulting engineers, and other interested parties with technical information for use in the design and construction of rural telephone systems. It gives basic considerations for (1) treatment of each existing facility to be retained to meet present day usage, (2) addition of facilities to upgrade existing subscribers to all one-party, and (3) future service requirements.
- 1.2 Plant reinforcement requirements--Unless they have in the past, presented the adding the limits of construction within the which results in idle plant or (2) costly additional reinforcements. eliminate extravagant plant approach to design engineering to pr and cutover and (2) most importan of solid-state pair gain (carrier a and other transmission devices.
- 1.3 To formulate additions to plant, the design engineer should (1) know the existing system and (2) understand the basic operational

problems which occur daily. These two factors will substantially assist the engineer in recommending the proper construction and cutover sequence.

1.4 The conversion process must be reviewed carefully as upgrading plans develop. In terms of the "flash cutover," (instantaneous) this could mean a substantial oversizing of facilities, or high labor cost outlays that may add little to the operation. It is possible that a "line at a time" cutover is impractical. More often, with careful design and conversion planning, a combination of the two will provide the best features of both. When it is necessary to provide facilities for conversion purposes, they are as much a part of design as those facilities required to meet subscribers' needs. Therefore, "conversion only" facilities need careful planning, and an effort should be made to work this into long range growth patterns.

1.5 When reinforcing and upgrading an existing system and planning to replace either an existing office with common control equipment or the installation of tone-dialing it will require a substantial change in the construction plan and sequence. This section is not intended to cover this.

2. CENTRAL OFFICE EQUIPMENT

2.01 Unbalanced originating traffic caused by improper line assignment is one of the most frequent problems, and yet can be the easiest to correct. A review of peg count readings, or, if not available, a line assignment review can be made in accordance with Exhibit I.

2.02 When power requirements at the busy hour or busy hours are greater than the output of the rectifier, the additional current required must come from the battery, causing the battery to discharge. Charging and discharging may lead to premature deterioration of the battery.

2.03 Loop failure, or "Threshold of Failure," can be determined by (1) adding resistance and (2) checking pulse distortion, using a pulse signaling test set (Northeast Electronics TTS26B and accessories, or equivalent). These tests, when compared with the specifications of the manufacturer, indicate the maintenance level of the operating company and will also assist the engineer with guide lines for costs of upgrading the existing equipment. Caution: Before making tests in paragraph 2.3, lift one lead off voltage meter in charger circuit to determine whether the meter is properly zeroed. Verify that full float voltage (51.5 - 52.8) is supplied to the central office under test.

2.04 Exhibit I--This exhibit proposes a 7 percent linear growth and is intended to be used for review and comparison. Experience has shown it is unwise to fill SxS line finder groups beyond 80 to 85

percent at conversion without accurate traffic data. This fill is based on trunking efficiency at conversion with less than accurate traffic data, and an expected 96 percent usage at the end of 5 years.

2.05 When expanding an existing central office from one- and four-party to all one-party with no accurate originating traffic data, it is suggested that subscribers with the same class of service (Urban Residence, Urban Business, Rural Residence, etc.) be distributed over all line groups subject to restrictions such as CMO, pay-stations, PBX, etc., as shown in Exhibit I. A complete traffic study should start during the busy season and not later than 12 months after upgrading is completed. It should be possible with reasonable record maintenance to achieve a 96 percent optimum fill on line finder groups, although steps should be taken well in advance of the point to assure the maximum fill is not exceeded.

2.06 Ringing machines will depend on the existing plant to be retained. Should existing station equipment be retained, it may be necessary to provide multifrequency ringing machines for the new system when new ringing machines are needed. Vibrator type ringing machines are inadequate with fine gauge design and may cause interference on loop plant. See TE & CM 212.

2.07 Main distributing frame space consideration will require ample lead time. Usually additions can be made to an existing MDF in the following manner: (1) using bunching block space for new pair terminations, (2) changing out old style protectors with new modules and (3) expanding upward.

2.08 Moving entrance cables is not recommended in most situations.

2.09 Single and multifrequency, reference tone generators, quiet termination, loop around and remote testing are most important additions to help achieve and maintain quality service. They are essential in preventive maintenance programs.

2.10 Loop extenders, voice frequency repeaters, and traffic registers should be centralized. Peg count meters shall have five digits.

2.11 See Exhibit II for further considerations for central office additions.

2.12 For additional items see Check List for SxS TPS COE Additions (Exhibit II).

3. OUTSIDE PLANT

3.1 Existing cable plant condition will usually range from poor to fair. Major causes are:

(1) Specifications under which system was built
(Transmission, housings, splicing, depth, gopher, etc.)

- (2) Location in right of way
- (3) Quality of construction
- (4) Quality of acceptance testing
- (5) Quality of maintenance

3.2 Before existing cables and other units of outside plant are considered for future usage, effort by project engineers and plant operating personnel should determine as quickly as possible whether the system is capable of meeting upgrading standards. This can be done effectively by making the following tests:

- (1) Transmission (voice frequency and carrier)
- (2) Electrical leakage, to ground to pairs.
- (3) Resistance and resistance unbalance
- (4) Noise (NM) (NG) (noise metallic and noise to ground) and balance
- (5) Mutual capacitance (sample)

These tests, if made correctly and properly analyzed, will provide most of the information needed to make a determination as to whether the existing plant can be retained in the upgraded system.

3.3 A review of plant maintenance history is important. The following should be checked:

- (1) Road moves (bad splicing, wrong gauges)
- (2) Method of repair (conductor insulation, cracking, purging, underground splicing, etc.)
- (3) Method of testing (have tests been made on a routine basis, how were tests made)

3.4 A field check of cable housings and condition should be made to determine suitability of existing housings for the upgraded system.

3.5 When making the overlay of plant additions, care should be taken to use pair-gain devices for feeders whenever possible and to use existing wire and cables for distribution purposes. Cable sizing guide lines are recommended in TE & CM 210.

3.6 When consideration is being given to retain an H-88 loading scheme, and the reinforcing facilities are to be part of that scheme, care must be taken that the existing load coil locations when applied to the new facilities will not result in an undesirable voice frequency response should it be necessary to locate the new loading points at other than the existing load points D-66 loading is recommended. In any event end sections should not exceed 9KF.

3.7 When a reinforcing cable is required, it generally should be feeders. Existing cables are more readily converted to distribution facilities and substantial recovery of otherwise "bad" or unusable pairs can be realized.

3.8 Existing coarse guage cables are usually not suitable for high efficiency feeder cables due to the following reasons: (1) Entering all pedestal housing. (2) Cable sizes too small in areas where station carrier facilities should be used. (3) Rehabilitation required to provide reliable carrier paths.

4. STATION EQUIPMENT

- 4.1 Troubles on drops, buried services, protectors, grounds, inside wire and station apparatus frequently account for more than 50% of plant troubles found. While station equipment amounts to 15% or less of the investment in rural systems it accounts for 1/3 to 1/2 of the annual maintenance.
- 4.2 Telephone sets exposed to open wire, will usually require rehabilitation.
- 4.3 500 type telephone sets which are served over cable facilities should perform satisfactorily.
- 4.4 Station items if retained generally require rehabilitation. Aerial drops may be introducing noise. Cords, dials and ringers have a high trouble rate. Existing ringers may be unsuitable for use on loops over 2000 ohms. Conversion to fuseless station protectors may significantly reduce maintenance.
- 4.5 Multifrequency ringing must be retained initially where old sets with multifrequency ringers are retained.
- 4.6 Ringers should be bridged. Telephone grounds, electric grounds and water systems should be bonded together.
- 4.7 General determination can be made from the records but inspection to determine rehabilitation of individual installations should be done as part of staking.
- 4.8 The testing and rehabilitation of telephone sets to be returned to service can be done in the following manner: (1) Starting with a suitable quantity of new replacement sets. (2) Install the new sets. (3) Bring the old sets back to rehabilitate or junk as necessary. (4) The original telephone sets are now ready to return to service.

5. BUILDINGS

- 5.1 When making additions to an existing central office building, floor space requirements should generally be based on a 25 year central office life. Floor space requirements must be considered for

- (2) Location in right of way
- (3) Quality of construction
- (4) Quality of acceptance testing
- (5) Quality of maintenance

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the following items:

- (1) Battery charging and power board
- (2) ANI and CMO
- (3) Voice frequency repeaters
- (4) Loop extenders
- (5) MDF additions
- (6) Carrier radio multiplex and concentrators
- (7) Connecting company requirements
- (8) Mobile radio systems
- (9) Register senders
- (10) Local message metering equipment
- (11) Standby engine generator
- (12) Rest room
- (13) Cable vault
- (14) File cabinet and desk
- (15) Switch repair space
- (16) Fire reporting equipment
- (17) Centralized test equipment
- (18) Custom calling equipment
- (19) Automatic toll ticketing
- (20) Alarm sending equipment.

5.2 Usually the battery must be relocated; therefore, this space could be used in other ways.

5.3 When building additions must be made, plans should include consideration of future replacement of SxS equipment. In replacing an operating system, extra floor space must be provided during the replacement process.

6. CONSTRUCTION TIME

6.1 Construction Time and Sequence Chart--Exhibit III is a guide to use in discussing and coordinating activities. The chart, if properly prepared, will provide work priorities and assist in personnel management, which will keep the project moving without undue interruption of service and at the same time prevent duplication of effort.

III will provide an overall picture. It is recommended that a more detailed chart be prepared. Numerous phases be prepared. Numerous to convert in the shortest possible amount of construction and engineering time.

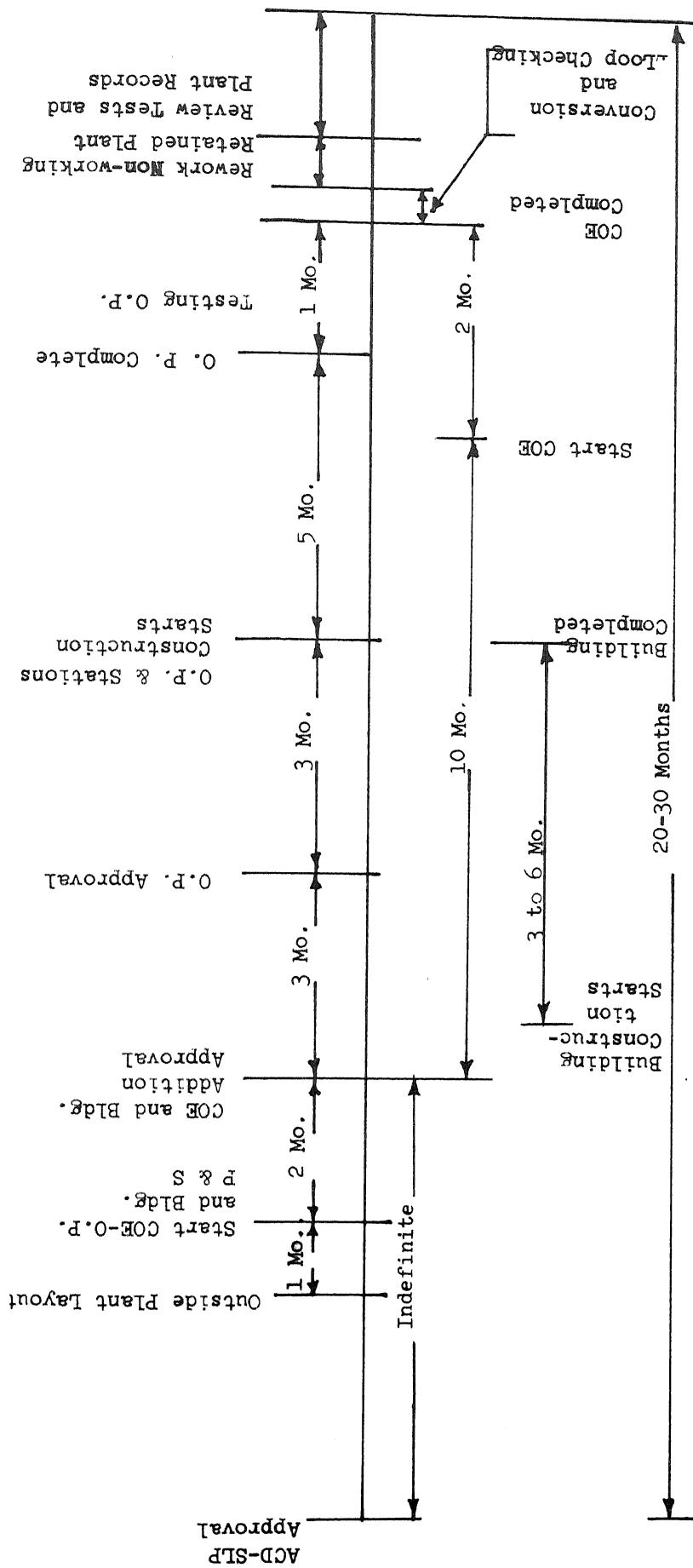
The final test should be that of results on operating plant records to reinforce the same acceptance that have been modified as are

LINE GROUPS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	8010	8011	8012	8013	8014	8015	8016	8017	8018	8019	8020	8021	8022	8023	8024	8025	8026	8027	8028	8029	8030	8031	8032	8033	8034	8035	8036	8037	8038	8039	8040	8041	8042	8043	8044	8045	8046	8047	8048	8049	8050	8051	8052	8053	8054	8055	8056	8057	8058	8059	8060	8061	8062	8063	8064	8065	8066	8067	8068	8069	8070	8071	8072	8073	8074	8075	8076	8077	8078	8079	8080	8081	8082	8083	8084	8085	8086	8087	8088	8089	8090	8091	8092	8093	8094	8095	8096	8097	8098	8099	80100	80101	80102	80103	80104	80105	80106	80107	80108	80109	80110	80111	80112	80113	80114	80115	80116	80117	80118	80119	80120	80121	80122	80123	80124	80125	80126	80127	80128	80129	80130	80131	80132	80133	80134	80135	80136	80137	80138	80139	80140	80141	80142	80143	80144	80145	80146	80147	80148	80149	80150	80151	80152	80153	80154	80155	80156	80157	80158	80159	80160	80161	80162	80163	80164	80165	80166	80167	80168	80169	80170	80171	80172	80173	80174	80175	80176	80177	80178	80179	80180	80181	80182	80183	80184	80185	80186	80187	80188	80189	80190	80191	80192	80193	80194	80195	80196	80197	80198	80199	80200	80201	80202	80203	80204	80205	80206	80207	80208	80209	80210	80211	80212	80213	80214	80215	80216	80217	80218	80219	80220	80221	80222	80223	80224	80225	80226	80227	80228	80229	80230	80231	80232	80233	80234	80235	80236	80237	80238	80239	80240	80241	80242	80243	80244	80245	80246	80247	80248	80249	80250	80251	80252	80253	80254	80255	80256	80257	80258	80259	80260	80261	80262	80263	80264	80265	80266	80267	80268	80269	80270	80271	80272	80273	80274	80275	80276	80277	80278	80279	80280	80281	80282	80283	80284	80285	80286	80287	80288	80289	80290	80291	80292	80293	80294	80295	80296	80297	80298	80299	80300	80301	80302	80303	80304	80305	80306	80307	80308	80309	80310	80311	80312	80313	80314	80315	80316	80317	80318	80319	80320	80321	80322	80323	80324	80325	80326	80327	80328	80329	80330	80331	80332	80333	80334	80335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EXHIBIT II

Suggested Checklist for SxS TPS Additions

1. One-way trunks power requirements, ANI, toll ownership, new trunk groups.
2. Review ACD or SLP for subscriber growth.
3. Inventory existing equipment and revise existing floor plan, if necessary.
4. Revise existing switching schematic to show updated inventory and location of existing equipment.
5. Revise existing switching schematic to show proposed equipment location, quantity of equipment to be ordered, and proposed traffic data. (Caution: Do not plan to move working traffic paths from existing equipment before upgrading.)
6. Consideration should be given to miscellaneous materials such as power wiring, fusing, racks, cabling to bring the office into operating condition.
7. List any materials or equipment to be supplied by owner.
8. How is long line treatment to be handled?
9. Will standby engine generator be installed? Who will furnish? Who will install?
10. Will conversation timing be eliminated?
11. How will long line treatment be accomplished?
12. Have all trunk requirements been shown on switching schematic?
13. Will the existing charger and battery be adequate in the new system?
14. How will the MDF be expanded and what changes will be required in entrance cables?
15. Has adequate provision been made for relay racks for carrier, concentrators, etc.



NOTES:

1. COE addition
2. O.P. reinforcement one- and four-party to one-party (210 miles)
3. Telephone sets, some added, some retained, 1758 subscribers at ACS - 1873 at conversion
4. 2188 5 year subscribers

CONSTRUCTION TIME AND SEQUENCE CHART

EXHIBIT III